CLAIMS

1. A laser processing apparatus for irradiating a wafer-like object to be processed with laser light while locating a light-converging point within the object so as to form a modified region by multiphoton absorption within the object, the apparatus comprising:

a beam expander for enlarging a beam size of the laser light emitted from a laser light source;

a condenser lens for converging the laser light incident thereon by way of the beam expander into the object; and

a lens holder holding the condenser lens and including a first light-transmitting hole for making the laser light incident on the condenser lens;

wherein a stop member having a second light-transmitting hole for narrowing and transmitting the laser light is disposed on an optical path of the laser light connecting the beam expander and the first light-transmitting hole to each other and is separated from the lens holder.

2. A laser processing apparatus according to claim 1, wherein, when the laser light emitted from the beam expander is substantially parallel light,

the second light-transmitting hole has a diameter not greater than that of the first light-transmitting hole.

3. A laser processing apparatus according to claim 1, wherein, when the laser light source emits the laser light at a beam diameter φ_0 and a divergence angle $2\theta_0$, and the beam expander enlarges the beam size of the laser light by a magnification M and emits the laser light at a divergence angle $2\theta_1$;

assuming that d_1 is the distance between an exit part of the laser light source and an entrance part of the beam expander, d_2 is the distance between an exit part of the beam expander and an entrance opening of the second light-

transmitting hole, and d_3 is the distance between the entrance opening of the second light-transmitting hole and an entrance opening of the first light-transmitting hole; and

letting φ_L be the diameter of the first light-transmitting hole, and φ_S be the diameter of the second light-transmitting hole;

φ_L and φ_S satisfy the relationship of

$$\frac{\phi_L\{M(\phi_0+2d_1\tan\theta_0)+2d_2\tan\theta_1\}}{M(\phi_0+2d_1\tan\theta_0)+2(d_2+d_3)\tan\theta_1}\geq\phi_S.$$

4. A laser processing apparatus according to claim 1, wherein, when the laser light source emits the laser light at a beam diameter φ_0 and a divergence angle $2\theta_0$, and the beam expander enlarges the beam size of the laser light by a magnification M and emits the laser light at a convergence angle $2\theta_1$;

assuming that d_1 is the distance between an exit part of the laser light source and an entrance part of the beam expander, d_2 is the distance between an exit part of the beam expander and an entrance opening of the second light-transmitting hole, and d_3 is the distance between the entrance opening of the second light-transmitting hole and an entrance opening of the first light-transmitting hole; and

letting φ_L be the diameter of the first light-transmitting hole, and φ_S be the diameter of the second light-transmitting hole;

φ_L and φ_S satisfy the relationship of

$$\frac{\phi_L\{M(\phi_0+2d_1\tan\theta_0)-2d_2\tan\theta_1\}}{M(\phi_0+2d_1\tan\theta_0)-2(d_2+d_3)\tan\theta_1}\geq\phi_S.$$